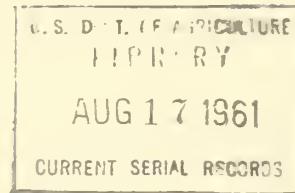


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INSECT
Prevention
and Control in
FARMERS
STOCK
PEANUTS

AGRICULTURAL MARKETING SERVICE



MARKET QUALITY RESEARCH DIVISION

U. S. DEPARTMENT OF AGRICULTURE

PREFACE

This publication supersedes AMS-337, "Suggestions for Insect Control in Farmers Stock Peanuts." It includes the most recent findings and recommendations for protecting farmers stock peanuts against infestation by several species of beetles and moths commonly found in the crop. Methods of prevention and control are presented in detail for practical application.

Washington, D. C.

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INSECT PREVENTION AND CONTROL IN FARMERS STOCK PEANUTS

Prepared by
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Insect infestation and damage constitute one of the major problems in storing farmers stock peanuts. The U. S. Department of Agriculture has conducted studies during the last few years on this problem. Although much remains to be learned, measures have been developed that will give satisfactory results under most conditions if they are carried out properly.

The studies were conducted primarily in the Southeastern peanut production area. Interpolations have been made to cover variations that may be required for the Southwestern and Virginia production areas. The suggestions are based on the best information now available (July 1961).

SUMMARY OF SUGGESTIONS FOR CONTROL

1. Clean up the warehouse inside and outside before storing peanuts in it. Burn or remove all refuse.
2. Apply a DDT or malathion residual spray after cleanup and before any peanuts are stored.
3. Apply a malathion or synergized pyrethrum protective treatment to the peanuts as they go into storage. This is to eliminate any low level of insect infestation present and prevent buildup of infestation during storage.
4. Apply a malathion or synergized pyrethrum surface spray on a routine schedule to maintain an effective insecticide deposit on the surface.
5. Use synergized pyrethrum space sprays to supplement bulk and surface treatments if a moth outbreak occurs. This can be repeated until infestation is under control.
6. Fumigate with methyl bromide or HCN after all peanuts are in the warehouse if a protective treatment has not been applied or if there is a heavy insect infestation, and if the warehouse is tight enough to be fumigated.

THE INSECT PROBLEM

Contributing Factors

Many factors make insect prevention and control in stored farmers stock peanuts one of the more difficult problems in the entire field of stored-product entomology. Heavy population densities result from the long warm season, the many generations of insects that are able to develop, the abundant food supply, and the absence of severe winter cold to kill back the infestations to low levels. Proper control measures are difficult or impossible to apply in many storage warehouses because design and construction are so poor that insects can get in easily.

An important factor contributing to the insect problem is the change in harvesting practice to windrowing and combining the peanuts. This has caused an increase in cracked pods and loose shelled kernels, a condition that favors the insects and further increases the severity of the problem during storage. The combined peanuts are brought into storage earlier than stacked peanuts and have more time to develop heavy infestations in the warehouse during the warm, humid fall season. Careless handling and excessive or unnecessary trampling of the peanuts causes additional cracking and shelling.

There is a danger of adding to the insect infestation by using old, infested burlap bags to catch the peanuts coming from the combine. It is important to use only clean or new bags for this purpose. Holding the peanuts on the farm for a time before they are taken to the warehouse can be an added source of trouble if the holding area is infested with insects from old peanuts, feed, or grain. Infestation can be picked up even from contaminated truck beds.

Surveys of hundreds of truckloads of peanuts arriving at warehouses in Georgia during the harvest period revealed that insect infestation was already present in practically all peanut stocks as received. The level of infestation was low, but was enough to start a vigorous infestation in the storage warehouse. The kinds of insects that cause the most damage in storage were commonly present in the incoming peanuts. When this situation was first observed, it was thought to be due to unusual conditions during that particular harvest season. However, extensive observations during four full seasons beginning in 1955 showed that the same situation occurred each season. Insects were present in all peanut stocks arriving at warehouses over a wide area in Georgia, where conditions were representative of much of the entire peanut production region.

Additional sources of infestation exist in many warehouses where old peanuts are lodged on or in ledges, beams, window sills, elevators, elevator wells, conveyors, and other places. Spilled peanuts, grain, or animal feeds under or near the warehouse may also be sources of infestation.

Insects Involved

Two distinct groups of insects attack farmers stock peanuts. One is composed of several species of beetles, such as the saw-toothed grain beetle, the flour beetle, the cigarette beetle, the cadelle, and the cornsaw beetle. The other consists of several species of moths, the most important of which are the Indian-meal moth and species of the genus Ephestia. Infestation by the beetles occurs in the bulk or within bags of stored peanuts, and therefore is not evident to the warehouseman. The beetles are, however, responsible for a large part of the kernel damage during storage. The moths are on the upper surface of bulk peanuts or on the outer surface of stacked bagged nuts. A moth infestation is very noticeable because the larvae crawl freely on the surface of the peanuts or bags and leave a noticeable webbing over the surface. Furthermore, the adults fly freely and can become very numerous in the headspace of the warehouse or between stacks of bagged peanuts.

A full description of the life cycle, habits, and appearance of the peanut pests named above is given in Farmers' Bulletin No. 1260, Stored Grain Pests, issued by the U. S. Department of Agriculture and available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 25 cents.

TREATMENT OF WAREHOUSE

Cleanup of Warehouse and Environs

Before storing peanuts, thoroughly clean the warehouse and its surroundings. Clean up trash and old remains or spillage of peanuts, grain, or animal feed, inside and around the warehouse. Pay particular attention to areas underneath loading platforms and underneath the building if it is raised off the ground. Material often collects in such places, becomes heavily infested with insects, and serves as an additional source of infestation for new-crop peanuts when they are brought in.

Clean out elevators, conveyors, elevator or conveyor wells, and any other spots where old peanuts and refuse have collected. Sweep down the walls, window sills, rafters, beams, ledges, and other parts of the building where old peanuts, grain, and dust can lodge. Sweep out loose accumulations from cracks in old wooden floors.

Burn, bury, or remove from the premises all refuse collected in these operations.

Residual Spray

Apply a residual spray after the warehouse is cleaned, preferably 1 or 2 weeks before any peanuts are brought in. Spray the floors, walls, beams, and ceiling of the interior of the empty warehouse. Spray the outside walls of the building up to a height of 6 or 8 feet, or to the eaves if they are not

too high. Spray the ground to a distance of about 6 feet from the building where possible. If the warehouse is a raised structure, spray the pillars and at least a few feet of the underside around them and around the edges of the building where possible.

Use a 5-percent DDT or 3-percent malathion emulsion spray. Apply the spray at the rate of about 2 gallons per 1,000 square feet, or just before the point of runoff. If there is much area to cover, it is best to use a power sprayer with enough pressure for good penetration into cracks and protected places.

TREATMENT OF PEANUTS

Extensive laboratory and field tests have shown that a bulk treatment followed by periodic surface treatments is necessary to protect farmers stock peanuts against insect damage during storage. The purpose of the bulk treatment is to eliminate any insect infestation which may be present at the time the peanuts are placed in storage. The surface sprays applied periodically during the storage period maintain the residue on the exposed peanuts at a level high enough to prevent reinfestation. Malathion and synergized pyrethrum have been approved for both bulk and surface treatments. Tests conducted cooperatively between the USDA and several food industry firms show that the recommended malathion treatment has no adverse effect on the odor or flavor of peanut butter made from treated farmers stock peanuts.

Bulk Treatments

The bulk treatment consists of spraying the peanuts as they are placed in the bin or warehouse, or before they are bagged. A convenient place to locate the spray nozzle is at the discharge end of a conveyor. It is advisable to place a canvas hood on a frame over the area of the spray nozzle to reduce air currents and prevent excessive loss of the spray. The spray should be coarse. It should be applied uniformly, preferably by using a mechanical applicator that regulates the rate of application to the flow of peanuts. The size of the nozzle opening and the operating pressure on the spray line must be calibrated with the rate of flow of peanuts on the conveyor to give the proper rate of application. A gear pump is satisfactory for use with the emulsion spray. The wettable-powder spray causes excessive wear on a gear pump, and it is therefore best to use a piston-type pump equipped with an agitator for this formulation. Use good spray equipment.

Premium-grade malathion and pyrethrum in combination with piperonyl butoxide have been approved for use on farmers stock peanuts, providing the residue on the shelled nuts is within the established tolerance of 8 p.p.m. (parts per million) for malathion, and 1 and 8 p.p.m. for pyrethrum and piperonyl butoxide, respectively.

The rates of application as recommended here, theoretically will exceed the tolerance on the farmers stock peanuts, but the insecticide residues on the nuts after the shell is removed and discarded are well within the tolerance established under the Food, Drug, and Cosmetic Act.

The recommended formulations and quantities to add to 5 gallons of water required for the bulk treatment of 15 tons of farmers stock peanuts are:

- (1) Emulsifiable concentrate containing 57 percent of premium-grade malathion----- $2\frac{1}{2}$ pints
- (2) Emulsifiable concentrate containing 6 percent of pyrethrins and 60 percent of piperonyl butoxide-----3 pints
- (3) Wettable-powder containing 2 percent of pyrethrins and 20 percent of piperonyl butoxide----- $8\frac{1}{2}$ pounds

Surface Treatments

The surface treatment consists of applying an insecticide over the top of bulk stored peanuts or over the outside surfaces of stacked bagged peanuts. The surface sprays help maintain an insecticide level that is toxic to invading insects.

As soon as the warehouse is filled, level off the top of the piles to eliminate peaks and mounds. A level surface is easier to spray and also helps prevent shifting. After the peanuts have been leveled off, lay boards over the surface to serve as a catwalk for the spray operator and for workmen and inspectors. Walking over the surface of sprayed peanuts disturbs the continuity of the deposit of insecticide and reduces the effectiveness of the treatment. Spray under the boards each time a surface treatment is made. Always leave enough headspace above your load to permit you to perform these operations efficiently and effectively.

Farmers stock peanuts in bags should be arranged in carefully prepared stacks not more than 30 feet square. The stacks should be completely surrounded by 3-foot aisles to enable the operator to spray thoroughly the outside surface of each stack of bags. The aisles also make it possible for the warehousemen to inspect the peanuts more thoroughly.

Power equipment is best for applying surface sprays. Small-capacity garden-type compressed-air sprayers do not have agitators and are therefore not satisfactory for applying wettable-powder sprays. They are inefficient and too slow for treating the large surface areas in many warehouses. The spray stream from power equipment reaches further and requires less walking over the surface of the peanuts. Power sprayers have greater capacity and a higher rate of delivery, and can do the job in less time. They also have agitators, which are necessary for wettable-powder sprays and desirable for emulsions. They have a constant nozzle pressure, which provides uniform application.

A piston pump is necessary for applying wettable powders, because the inert ingredients cause a gear pump to wear out rapidly.

The operating pressure and nozzle opening combination should be adjusted to deliver a coarse, wet spray.

In the Southeastern production area, the first surface treatment to bulk-stored farmers stock peanuts should be applied as soon as all of the peanuts are in and the surface has been leveled off. The first treatment should be applied no later than October 1, even though all the peanuts may not be in at that time. The schedule for later treatments with malathion and synergized pyrethrum is shown below:

Malathion:

Wettable powder containing 25 percent of premium-grade
malathion----- $1\frac{3}{4}$ pounds
Water-----2 gallons
Application rate: 2 gallons per 1,000 square feet of surface.

Frequency of application:

Southeastern production area: Apply first surface treatment as soon as the bin is filled and leveled, but not later than the first week in October. Apply second treatment one month later, followed by subsequent treatments at 2-month intervals.

Southwestern production area: Apply first surface treatment as soon as bin is filled and leveled off or bags are stacked. Apply second treatment about March 1, followed by subsequent treatments at 2-month intervals.

Virginia production area: Apply first surface treatment as soon as bin is filled and leveled off or bags are stacked. Apply second treatment about April 1, followed by subsequent treatments at 2-month intervals.

Synergized Pyrethrum:

Both wettable-powder and oil-base surface sprays containing synergized pyrethrum have been approved for use on farmers stock peanuts. The formulations and rates of application are:

Wettable powder containing 2 percent of pyrethrins and
20 percent of piperonyl butoxide-----9 ounces
Water-----2 gallons
Application rate: 2 gallons per 1,000 square feet of surface.

Pyrethrins-----0.2 percent
Piperonyl butoxide-----2.0 percent
Petroleum distillate (deodorized kerosene)-----97.8 percent
Application rate: $1\frac{1}{2}$ gallons per 1,000 square feet of surface.

The pyrethrins content of the oil-base spray should not be less than 0.2 percent, otherwise the volume of spray required per 1,000 square feet of surface becomes excessive. It is imperative that a good grade of petroleum distillate be used, otherwise tainting of the peanuts may result or there may be an accumulation of undesirable oily deposit. Suggested specifications for the oil are as follows:

Specific gravity at 60° F.	-----0.77 - 0.80
Flash point (Tag closed cup)	-----140° F. minimum, 160° - 170° F. preferable
Initial boiling point	-----370° F. minimum
Distillation end point	-----490° F. maximum
Unulfonated residue	-----97 percent minimum
Color	-----Water white
Odor	-----Neutral, no kerosene or naphtha odor, no residual odor

In the Southeastern production area, the first application should be made as soon as all of the peanuts are in and the surface has been leveled off, but not later than October 1. Use double the concentration of insecticide recommended here for the first surface treatment, as well as for the second, which should be applied 7 days later. This is to build up a heavy deposit in a hurry. Later applications can be made at the normal concentrations specified and should continue at 7-day intervals through November. After that, the applications can be spaced at 15-day intervals through the rest of the storage period.

In the Southwestern production area, records show little or no fall infestation, so spray applications may be deferred until spring. In areas south of the latitude of Waco, Tex., the first application should be made about March 1. Use double the concentration of insecticides recommended above for the first surface treatment, as well as for the second, which should be applied 7 days later. Continue the treatments at 7-day intervals through March, and at 15-day intervals thereafter. In areas north of Waco, the spray program should be started April 1, with 7-day intervals through April and 15-day intervals thereafter.

In the Virginia production area, the situation is similar to that in the Southwestern area. The spray schedule should be started April 1, and continued at 7-day intervals through that month and at 15-day intervals thereafter.

In calculating the area to be sprayed for piles of bulk peanuts or stacks of bagged peanuts, use the actual surface as the area, for it will be larger than the floor area under the pile or stack.

Fumigation

Fumigation is effective only in tight structures such as concrete silos, steel buildings with sealed joints, or tight wooden structures with concrete floors. The fumigation must be conducted only by experienced operators who know how to do the job effectively and safely.

Only two fumigants can legally be used on peanuts at this time. Tolerances have been established for these fumigants under Section 408 (Miller Amendment) of the Food, Drug, and Cosmetic Act. These tolerances are 200 p.p.m. of methyl bromide and 25 p.p.m. of hydrogen cyanide (HCN). Studies have been conducted with other fumigants previously used on peanuts, to develop data for consideration in proposing tolerances that will permit their use again.

The dosage rate for either methyl bromide or HCN varies between 1 and 2 pounds per 1,000 cubic feet, depending on local conditions, the condition of the peanuts, and the tightness of the structure. Before peanuts are fumigated for the third time with methyl bromide, a chemical analysis should be made to determine whether the inorganic bromide residue is approaching the tolerance of 200 p.p.m. A trial lot should also be fumigated to determine whether a third fumigation will cause any objectionable odor or flavor, which can be produced by excessive fumigation with methyl bromide.

SPACE TREATMENTS

Space treatments with aerosols are easily applied, and the results are immediately noticeable and appear somewhat spectacular. For these reasons, many warehousemen favor the use of space treatments. The control or prevention obtained from such treatments is very limited, however. They are effective for only the few minutes during which the insecticide is suspended in the air and in direct contact with the insects. Moths are killed by space treatments, but they are capable of laying large numbers of eggs before dying. No effective residue remains to protect the peanuts between treatments. Space treatments should be used as a supplement to and not as a substitute for surface spraying when a heavy or persistent insect infestation develops.

There are two general classes of aerosol generators, mechanical and thermal. The mechanical types are generally smaller, have less capacity, and generate an aerosol with larger particle size. These are most suitable for use in individual warehouses. Most of the thermal types are larger and are suitable where a number of warehouses are to be treated with one machine. Any type is suitable, provided the formulation recommended for that type is used. The generators should be set for small particles, about 5 to 10 microns mass median diameter. The aerosol should be released into the building from the windward side so that good distribution will be obtained.

The formulations recommended for the two classes of generators are:

Formulation No. 1 (for use in mechanical generators):

	Percent (by weight)
Pyrethrins-----	0.5
Piperonyl butoxide-----	5.0
Tetrachloroethylene-----	50.0
Deodorized kerosene-----	44.5

Mixing directions when formulated on the job:

	<u>Pints</u>
Concentrate containing 5 percent of pyrethrins and 50 percent of piperonyl butoxide-----	2
Tetrachloroethylene-----	6
Deodorized kerosene-----	8

Application rate:

1 pint per 10,000 cubic feet of space above the load, or 2 gallons to an average warehouse 100 x 100 feet with 15 to 20 feet of space above the load.

Note: Where peanuts are piled almost to the roof, apply as a wet spray to the top surface of the load, at the rate of 2 gallons per 100 x 100 feet of surface.

Formulation No. 2 (for use in thermal-type generators):

	<u>Percent</u> <u>(by weight)</u>
Pyrethrins-----	0.2
Piperonyl butoxide-----	2.0
Tetrachloroethylene-----	50.0
Deodorized kerosene-----	47.8

Mixing directions when formulated on the job:

	<u>Pints</u>
Concentrate containing 5 percent of pyrethrins and 50 percent of piperonyl butoxide-----	1
Tetrachloroethylene-----	6
Deodorized kerosene-----	9

Application rate:

2½ pints per 10,000 cubic feet of space over the load, or 5 gallons to an average warehouse 100 x 100 feet with 15 to 20 feet of space above the load.

CAUTION:

Operators should be especially cautious to avoid exposure to and prolonged breathing of tetrachloroethylene fumes. The maximum allowable concentration has been established at 200 p.p.m.

PREVIOUS ISSUES OF THIS SERIES RELATED TO STORED-PRODUCT INSECTS

- AMS-4 Fumigation of Dry Beans and Cowpeas on the Packaging Line. Jan. 1955
- AMS-5 Procedure for the Fumigation of Dry Beans and Cowpeas on the Packaging Line. Jan. 1955.
- AMS-49 Timing of Sprays to Control the Cigarette Beetle. May 1955.
- AMS-58 An Insect Preventive Program for Peanut Warehouses. June 1955.
- AMS-64 Protecting Stored Seed from Insect Attack. (Revision of former Bureau of Entomology and Plant Quarantine publication E-677, issued December 1945.) July 1955.
- AMS-73 Effect of Varying the Volatilization of Methyl Bromide by Combinations with Various Solvents on its Distribution in Bulk Grain Fumigation. Dec. 1955.
- AMS-101 Studies on Separation of Weevil-Infested from Noninfested Wheat by Flotation. Mar. 1956.
- AMS-131 Enclosures for Fumigating Stored Raisins. July 1956.
- AMS-150 Experiments on Distributing Methyl Bromide in Bulk Grains with Aeration System. Jan. 1957.
- AMS-151 Experiments on Distributing Liquid Fumigants in Bulk Grains with Aeration System. Jan. 1957.
- AMS-152 Experiments on Distributing HCN in Bulk Grain with Aeration System. Jan. 1957.
- AMS-214 Studies of DDVP for Control of Cigarette Beetles in Tobacco Warehouses. Nov. 1957.
- AMS-218 Observations of the Effect of Packaging Temperature of Nonfat Dry Milk on Insects in the Containers. Nov. 1957.
- AMS-273 Control of Insects that Attack Dried Beans and Peas in Storage. Aug. 1958.
- AMS-302 Insect Prevention and Control in Plants Processing Dry Milk. Apr. 1959.
- AMS-343 A Cleaner for Removing Insects from Raisins. Oct. 1959.
- AMS-390 A Summary of Information about the Khapra Beetle. July 1960.
- AMS-439 Controlling the Cigarette Beetle in the Tropics. Apr. 1961.